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ORIGINAL ARTICLE

Prevalence of Diseases associated with Air Pollution considering the use of Solid Fuels in Rural Households in Kurdistan - Iran in 2012

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ABSTRACT
Solid fuels are the main sources of energy mostly in the rural areas. These inefficient fuels expose approximately 50% of the world population to the harmful effects of these combustion products. According to World Health Organization reports, more than 1.6 million deaths and over 38.5 million disabilities was recorded due to solid fuel consumption. This article focuses on the use of solid fuels for cooking and, the aim of this study was to evaluate the relationship between Solid Fuel Use and asthma, tuberculosis, respiratory infections and low birth weight in households in the rural setting of Kurdistan, Iran.This research was conducted in 329 villages of Kurdistan in which solid fuels were used, from September 2012 to September 2013. All relevant information (ie, bread place, presence of a kitchen, and type of fuel used by the household) were recorded from a checklist, during this study. The results are presented in the form of odds ratios (ORs) with 95% confidence intervals (CIs). For statistical analysis, a statistical software package (EPI-Info, version 6.0) was used. Findings from this study showed a positive association between the consumption of solid fuels and prevalence of respiratory infections (OR = 3.16, 95% CI = 2.37-4.2) and, asthma (OR = 2.39, 95% CI = 1.73-3.29), but the relationship between consumption of solid fuels and prevalence of tuberculosis (OR = 2.87 95% CI =0.71-9.71), and low birth weight (OR = 1.15, 95% CI =0.6-2.14) were not significant. Also we found that 5284(3.86 %) of the households in rural areas of Kurdistan used solid fuels, including 32.7% wood and 67.3% biomass for cooking. Average cooking time in these households was assessed more than four hours per day. This research shows that 76.08% of households cook the meals with traditional stoves without proper ventilation, and 42.8% of households have poor housing conditions. The results of this study indicate the significant associations between asthma and, respiratory infections in the respondents and the use of solid fuel but now significant associations between tuberculosis and, low birth weight. The coordinated, consistent, and focused cooperation of all stakeholders at the grassroots, policy-making, and implementation levels is needed for these areas of the country. An attempt should also be made to address the suffering of women, and a proper treatment strategy should be considered for this female population.
Keywords: *solid fuel, tuberculosis, indoor pollution, asthma, respiratory infection*

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INTRODUCTION

Solid fuels (coal and biomass) are the main domestic source of energy and about 50% of global households and 90% of rural households consume them. These products have harmful effects and expose 50% or around three billion humans into danger [1]. More than 1.6 million deaths and over 38.5 million life adjusted disabilities years can be attributed to indoor smokes rising from solid fuels which affect mainly children and women [2].

Wood and other forms of biomasses such as animal dung, crop residues, and so forth are often used as sources of energy in the developing countries [3]. Poorly designed/ manufactured stoves and fireplaces, burning solid fuels, as well as agricultural fires, emit significant quantities of health-damaging pollutants and carcinogenic compounds including respirable particles, carbon monoxide, nitrogen and sulphur

oxides, benzene, formaldehyde, 1,3-butadiene, and polyaromatic compounds such as benzo (α) pyrene [4].

Exposure to the above toxic particles at the levels of indoors cooking with solid fuels causes death due to certain diseases, and the most significant correlation is between indoor air pollution and acute lower respiratory infection (ALRI) [5, 6] chronic obstructive pulmonary disease (COPD) [7] and lung cancer in the case of coal smoke [8]. There is emerging evidence that indoor air pollution increases the risk of other child and adult health problems, including low birth-weight, perinatal mortality, asthma, tuberculosis, nasopharyngeal cancer, cataracts, blindness, and cardiovascular disease [9].

Unfavorable housing and living condition causes respiratory disorders [10] thus house types were categorized by the quality materials used for construction of roof, walls and floor: brick, iron, wood and stone. Regarding the most epidemiological studies in developing countries and WHO global assessment [1, 11] the local population was divided two categories of people: exposed or not exposed to indoor smoke of solid fuels (on the basis of the energy sources used for cooking).

Efforts to reduce indoor air pollution from SFU centre on the four general categories of interventions listed below [12].

− Behavioral modifications to reduce exposure (e.g. encouraging mothers to keep their young babies away from the fire);

− Household changes to improve ventilation (e.g. increasing the number of open windows in the kitchen, providing gaps between the roof and walls, or moving the stove out of the living area);

− Improving the cooking stoves (e.g. ventilation by flues, hoods or chimneys, or increases in combustion efficiency - nearly all health damaging pollutants are products of incomplete combustion);

− Interventions to enable people to use higher-quality, lower-emission liquid or gaseous fuels (e.g. petroleum-based kerosene and liquid petroleum gas, or biomass-based alcohol and bio-gas).

This article focuses on the use of solid fuels for cooking and, the aim of this study was to evaluate the relationship between Solid Fuel Use and asthma, tuberculosis, respiratory infections and low birth weight in households in the rural setting of Kurdistan, Iran.

METHODS

A) Study site and population

The study was conducted in rural community in Kurdistan, Iran from April 2012 to April 2013. Although our country in terms of fuel resources such as oil and gas is rich, but more than 12% of the rural areas inhabitants utilize other fuels such as wood, agricultural waste, dung and charcoal for cooking and heating up, especially in the cold seasons use.

This research is a descriptive - cross sectional study conducted in the villages of Kurdistan in 2012. The study population were 427,031 households residing in 329 villages in four cities including Divandareh, Marivan, Sarvabad, and Dehgolan. Rural households in these cities used wood or biomass as solid fuel. In this study, the data related to the residential buildings of the households In terms of area, kitchen, bread baking place, ventilation system, type of construction, type of solid fuel consumption, number of air pollution-related diseases, including respiratory infections, tuberculosis, asthma and the number of low birth weights in the households using solid fuel (with an average of 4 hours per day cooking near a traditional oven) and lack of fuel in the checklists set by ministry of health management of air pollution control, environmental health and occupational health were considered. After doing home visits in the rural areas, according to the disease management protocols and family physicians guidelines and recorded cases in the patient care registration form in the health houses, they were evaluated during the twelve-month period.

B) Assessment of Health Outcomes

According to figures 1 and 2 the some of these households burn solid fuels, use inefficient devices, and often work in kitchens that are poorly ventilated; this praxis results in being exposed to multiple toxic products of incomplete combustion**.** The given data was examined on exposed and non exposed inhabitants and the fields were categorized in the form of whole building, the kitchen (indoor or outdoor), and the, bread place regarding the, ventilation status, building materials, and the amount and type of solid fuel consumption.

Figure1. A kitchen in Kurdistan

Figure2. A bread place in Kurdistan

Number of households consuming solid fuel: 100 * The total number of households / number of household use solid fuel
The number of households using solid fuel with a proper ventilation system: 100 * Number of households consuming solid fuel / solid fuel consumption of households with adequate ventilation.
Number of households consuming solid fuel with a kitchen and a place where good bread 100 * Number of households consuming solid / solid fuel consumption of household whit appropriate kitchen 100 * The number of households using solid fuel log / number of households using solid fuels (appropriate Bakers)
The number of households using solid fuel for residential space area: 100 * The number of household using solid fuel / consumption of household solid fuel for residential space

C) Data analyze

The results are presented in the form of odds ratios (ORs) with 95% confidence intervals (CIs). For statistical analysis, a statistical software package (EPI-Info, version 6.0) was used.

RESULTS

Findings from this study showed a positive association between the consumption of solid fuels and prevalence of respiratory infections (OR=3.16, 95% CI = 2.37-4.2) and, asthma (OR = 2.39, 95% CI = 1.73-3.29) there, but the relationship between the consumption of solid fuels and prevalence of tuberculosis (OR = 2.87 95% CI =0.71-9.71), and low birth weight (OR = 1.15 95% CI =0.6-2.14) not significant. According to the Table1, 5284(3.85 %) households of 137094 in rural areas of Kurdistan used solid fuels, including 32.7% wood and 67.3% dung for cooking. Average cook time in the households were assessed more than 4hours per day. This research shows that 76.08% of households cook the meals with traditional stoves without proper ventilation, and 42.8% of households have poor housing conditions. 3859 of the households (73.03%) in the villages cooked in the indoor fireplaces.

Table1 Household SFU in Kurdistan

Fuel type	**Estimate of household use (%)**
SFU	5284 (3.85)
Biomass	3557 (67.3)
Wood	1728 (32.7)

Table: 2 Odd ratio for health outcomes in this study for Kurdistan

Health outcomes	Strength of evidence	odds ratios	CI
asthma	Strong	2.39	1.73-3.29
tuberculosis	Weak	2.87	0.71-9.71
respiratory infections	Strong	3.16	2.37-4.2
low birth weight	Weak	1.15	0.6-2.14

Tabl 2 show the odd ratio for health outcomes in this study for Kurdistan. According that, A stronger association was observed to be respiratory infections and asthma than in tuberculosis and low birth weight.

According to Tabl 3, household use of solid fuels who have poor housing conditions were 1156 (20.9%), Cook in living room 1589 (30.1%), with Inadequate ventilation 1156(20.9%).

Tabl 3 invironmental factores of Household SFU in Kurdistan

County	Household use of solid fuels	poor housing conditions	Cook in living room	Inadequate ventilation	Type of house			
					wooden	stony	iron	other
Marivan	3207	323	560	323	0	1697	593	917
Divandarreh	1732	626	935	626	27	505	144	1056
Dehgolan	268	177	72	177	0	30	30	208
Sarvabad	78	30	22	30	12	36	12	18
Total	5284	1156	1589	1156	39	2268	779	2199

DISCUSSION

We observed the significant associations between asthma and, respiratory infections in the respondents and the use of solid fuel but no significant associations between tuberculosis and, low birth weight. Also 76.08% of households are cooking with traditional stoves without proper ventilation, and 42.8% of all households and, 20.9% household use of solid fuels have poor housing conditions in Kurdistan, Iran. The results of this study indicate that inadequate supply of clean fuels in rural areas contributes to the life difficulties, health problems, and economic loss of its population. Therefore, the coordinated, consistent, and focused cooperation of all stakeholders at the grassroots, policy-making, and implementation levels are required for these areas of the country.

Several studies have found significant associations between bronchitis in the respondents and the use of solid fuel. Laxmi et al., (2003) found that cooking with traditional methods without proper ventilation has adverse impacts on human health. According to this study from rural Rajasthan, India, even a partition between the kitchen and the living space can greatly reduce the health hazards of indoor air pollution. It is evident also that those women who were cooking in living rooms had a high prevalence of chronic bronchitis. The duration of cooking (in years) and the daily time spent on cooking (in hours) have a significant impact on the prevalence of chronic bronchitis and this ration is significantly higher among those women who had spent > 2 h on cooking for a period of > 10 years. Low incomes and large family sizes have significant influence on cough and phlegm [13].

A strong association was found between bronchitis in the respondents and the use of wood (OR, 2.38; 95% CI, 2.12 to 3.01), dung cake (OR, 2.01; 95% CI, 1.72 to 2.42), rice straws (OR, 3.32; 95% CI, 1.11 to 9.88), and kai grass (OR, 1.96; 95% CI, 1.75 to 2.45) in the test villages. The Student *t* test results were highly significant, (p= 0.0001) for all four categories of fuel consumption [14].

A recently published study in rural Guatemala found that babies born to women using wood fuel,compared to those using gas and electricity, were 63 gm lighter (95% CI 0.35-125.6; p=0.049)after adjustment for socio-economic and maternal factors (Boy et al., 2002) [15].

Ezzati, describes a cohort study of 345 rural Kenyan people (of which 93 were aged less than 5 years), living in 55 homes on a rural cattle ranch. Households used mainly wood or charcoal, in open fires and improved (chimneyless) stoves. Detailed personal exposure assessment was combined with weekly (initially bi-weekly) health outcomes assessment for adults and children using WHO criteria for ALRI. This is the first study that has reported (and presented) exposure-response relationships for particulates and incidence of ALRI, in children (less than 5 years) and adults. The trend of increasing risk with higher levels of exposure was highly significant [16].

Nigel et al., with Analysis of data from 200,000 Indian adults found an association between self-reported TB and exposure to wood smoke at interview in the 1992-93 National Family Health Survey. Persons

living in households burning biomass reported TB more frequently compared to persons using cleaner fuels, with an OR to 2.58 (1.98-3.37) after adjustment for a range of socio-economic factors [17].
Environmental health factors affecting health in the households using solid fuels are as follows:

- Environmental health of family accommodation
- windows and vents in the residential areas for home ventilation
- Sharing cooking area with other residential rooms
- Inappropriate area of residential space compared to the household population
- Lack of access to appropriated energy sources for heating and cooking
- Inadequate ventilation for heating and cooking equipments
- Keeping livestock wastes in the residential areas

These could be done using short term, medium term and long term to reduce health risks related to the air pollution in rural households using solid fuels:
Short-term interventions: including identification of environmental health status of rural households, modifying and reducing exposure and provision of short-term management strategies for target population.
Medium term interventions: Include estimates of household basic needs to achieve optimal indicators in Environmental Health accommodation, allocation of the necessary funds for accommodation rehabilitation and upgrading of the rural sanitation
Long-term interventions: identification of resources, possible sources of fuel available, and energy sources, rural development and access to cleaner fuel sources with lower emissions. Energy Conservation in villages, Cooperation with related institutions such as rural development, tribal affairs, and refined petroleum products Distribution Company and raising awareness of the rural population in Ventilation and housing sanitation, by health workers and health care workers can be effective in controlling related diseases.

CONFLICT OF INTERESTS

Authors have no conflict of interests.

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